

Figure 1

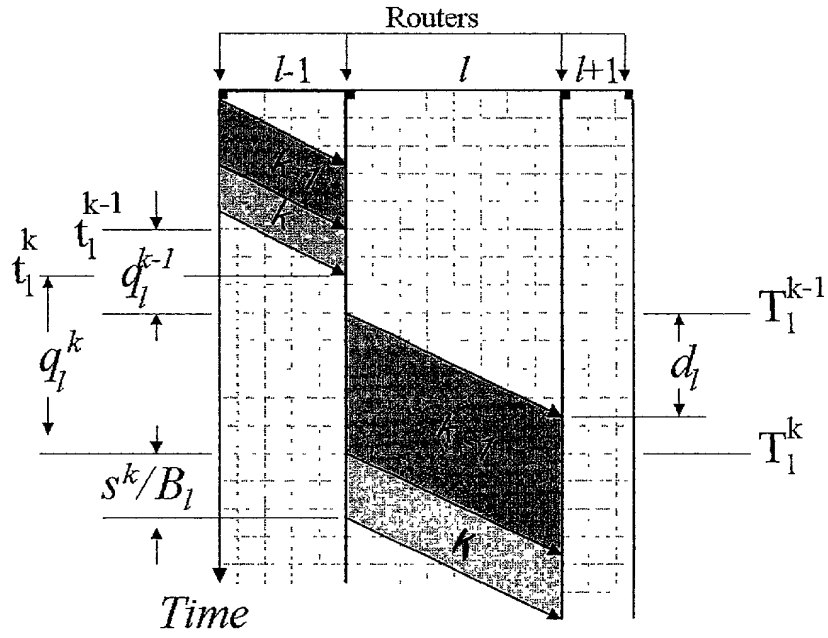


Figure 2

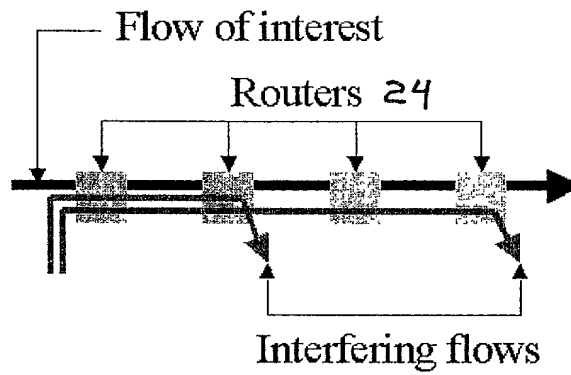


Figure 3

Probe 1		Probe 2		Routers	
Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
$\sum_{i=0}^{l-1} q_i^{probe_1}$	Max: $\hat{q}_i^{voice} + s^{probe_1} / B_i$  i=0, ..., l-1	$\sum_{i=0}^{l-1} q_i^{probe_2}$	Max: $\hat{q}_i^{voice} + s^{probe_2} / B_i$  i=0, ..., l-1	$\sum_{i=0}^{l-1} \hat{q}_i^{voice}$	$\sum_{i=1}^{l-1} \Delta q_i^{voice}$

Figure 4

Router (l)			
Forward	$\hat{q}_l^{voice}$	$q_{l_{previous}}^{voice}$	$\hat{\Delta q}_l^{voice}$
Reverse	$\hat{q}_l^{voice}$	$q_{l_{previous}}^{voice}$	$\hat{\Delta q}_l^{voice}$

Figure 5

	Probe Queuing Delay	Transmission Delay
Probe 1	$q_l^{probe_1}$	$(s^{probe_1} / B_l)$
Probe 2	$q_l^{probe_2}$	$(s^{probe_2} / B_l)$

Figure 6

	Inferred From Probe 1		Inferred From Probe 2		Network	Network
	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
Forward Collector	$\sum_{i=0}^{l-1} q_i^{probe_1}$	Max: $\sum_{i=0}^{l-1} q_i^{voice} + s^{probe_1} / B_i$ $i=0, \dots, l-1$	$\sum_{i=0}^{l-1} q_i^{probe_2}$	Max: $\sum_{i=0}^{l-1} q_i^{voice} + s^{probe_2} / B_i$ $i=0, \dots, l-1$	$\sum_{i=0}^{l-1} q_i^{voice}$	$\sum_{i=0}^{l-1} \Delta q_i^{voice}$
Reverse Collector	$\sum_{i=0}^{l-1} q_i^{probe_1}$	Max: $\sum_{i=0}^{l-1} q_i^{voice} + s^{probe_1} / B_i$ $i=0, \dots, l-1$	$\sum_{i=0}^{l-1} q_i^{probe_2}$	Max: $\sum_{i=0}^{l-1} q_i^{voice} + s^{probe_2} / B_i$ $i=0, \dots, l-1$	$\sum_{i=0}^{l-1} q_i^{voice}$	$\sum_{i=0}^{l-1} \Delta q_i^{voice}$

Figure 7

	Probe 1	Probe 2
Departure Time (From AR)	$T_{AR}^{probe_1}$	$T_{AR}^{probe_2}$
RTT (Round-Trip Time)	$RRT_{probe_1}$	$RRT_{probe_2}$
Arrival Time (At Correspondent Node)	$t_{CN}^{probe_1}$	$t_{CN}^{probe_2}$
Departure Time (From Correspondent Node)	$T_{CN}^{probe_1}$	$T_{CN}^{probe_2}$
Arrival Time (At AR)	$t_{AR}^{probe_1}$	$t_{AR}^{probe_2}$

Figure 8

<b>Delay (<math>\Delta</math>)</b>	$\tau_{total} = \tau_0 + \tau_1 + \dots + \tau_{l-1}$
<b>Jitter (<math>\Delta\tau</math>)</b>	$\Delta\tau_{total} = \sqrt{(\Delta\tau_0)^2 + (\Delta\tau_1)^2 + \dots + (\Delta\tau_{l-1})^2}$
<b>Bandwidth (<math>B</math>)</b>	$B_{total} = \{\min(B_i); i = 0, \dots, (l-1)\}$
<b>Packet Loss (<math>L</math>)</b>	$L_{total} = 1 - [(1 - L_0) \times (1 - L_1) \times \dots \times (1 - L_{l-1})]$

Figure 9

Phase 1: End-to-end QoS Estimation					
	Router Monitoring		Probing	Processing	L2+L3 Combining
	Queuing Estimate Updating	Jitter Estimate Updating			

Phase 2: AR/AP Selection						
	QoS Ranking		QoS Classification	Load Balancing	Cost- Awareness	User Preferences
	Weighting- Based	Perception- Based				

Figure 10